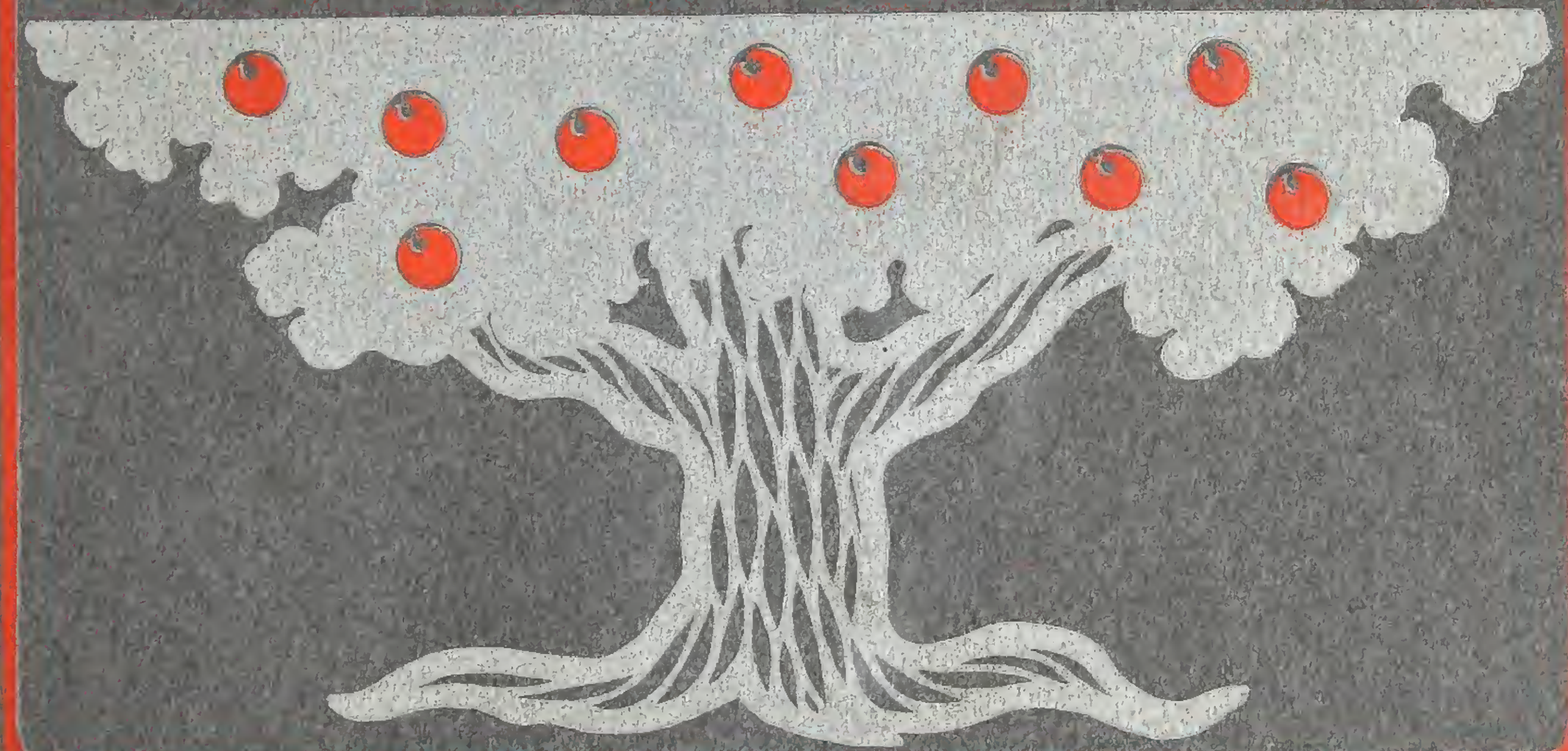
HOME INDUSTRY




THE CANADIAN PORTLAND CEMENT CO LIMITED
"RATHBUN'S STAR" BRAND
THE RATHBUN COMPANY DESERONTO ONT
WORKS AT STRATHCONA MARLBANK ONT

The Canadian Portland Cement Company, Limited

WORKS AT

STEINBECK, ONT.

MARLBANK, - ONT.

St. Lawrence Portland Cement Company

MONTREAL, - QUE.

CAPACITY
500,000
BARRELS PER ANNUM

Deseronto Ontario

The Canadian Portland Cement Company's Strathcona Plant, Strathcona, Ont.
Where "Rathbun's Star" Portland Cement is made

The Canadian Portland Cement Company's Marlbank Plant, Marlbank, Ont.
General View

The Story of Portland Cement

WE are largely indebted to Mr. John Smeaton, of England, for our present knowledge of cements, for in 1756 he made discoveries of improvements in limes and cements, and afterwards published them in his "Narrative of the Building of the Eddystone Lighthouse."

He was the first to break down the tradition that the purest and hardest limestones were the best, at least for hydraulic purposes, and the first to prove that the proper mixture of carbonate of lime and clay was what gave the best results. He was the first to discover that this mixture of carbonate of lime and clay was the real cause of hydraulicity. The Eddystone Lighthouse stands to-day not only as a guide to "ships that pass in the night," but also a monument to mark the starting point in all that we know concerning hydraulic cements.

From 1757 to 1824 very little advance was made in cement making, and no advance was made in our knowledge of cements beyond that left by Smeaton. A patent dated Dec. 15th, 1824, was granted to Joseph Aspdin, a bricklayer of Leeds, for the manufacture of Portland cement. All experimenters in Europe appeared satisfied with producing hydraulic lime, with the single exception of Aspdin. In the course of his experiments he hit upon a mixture of lime and clay, which when burnt at a high temperature and ground, formed, with water, a cement so much harder than anything before known, as to surprise him greatly, and he gave his new compound the somewhat misleading name of Portland cement. He chose this name in consequence of its fancied resemblance in point of color and texture to the oolitic limestone on the island of Portland, which was well known and in great favor as

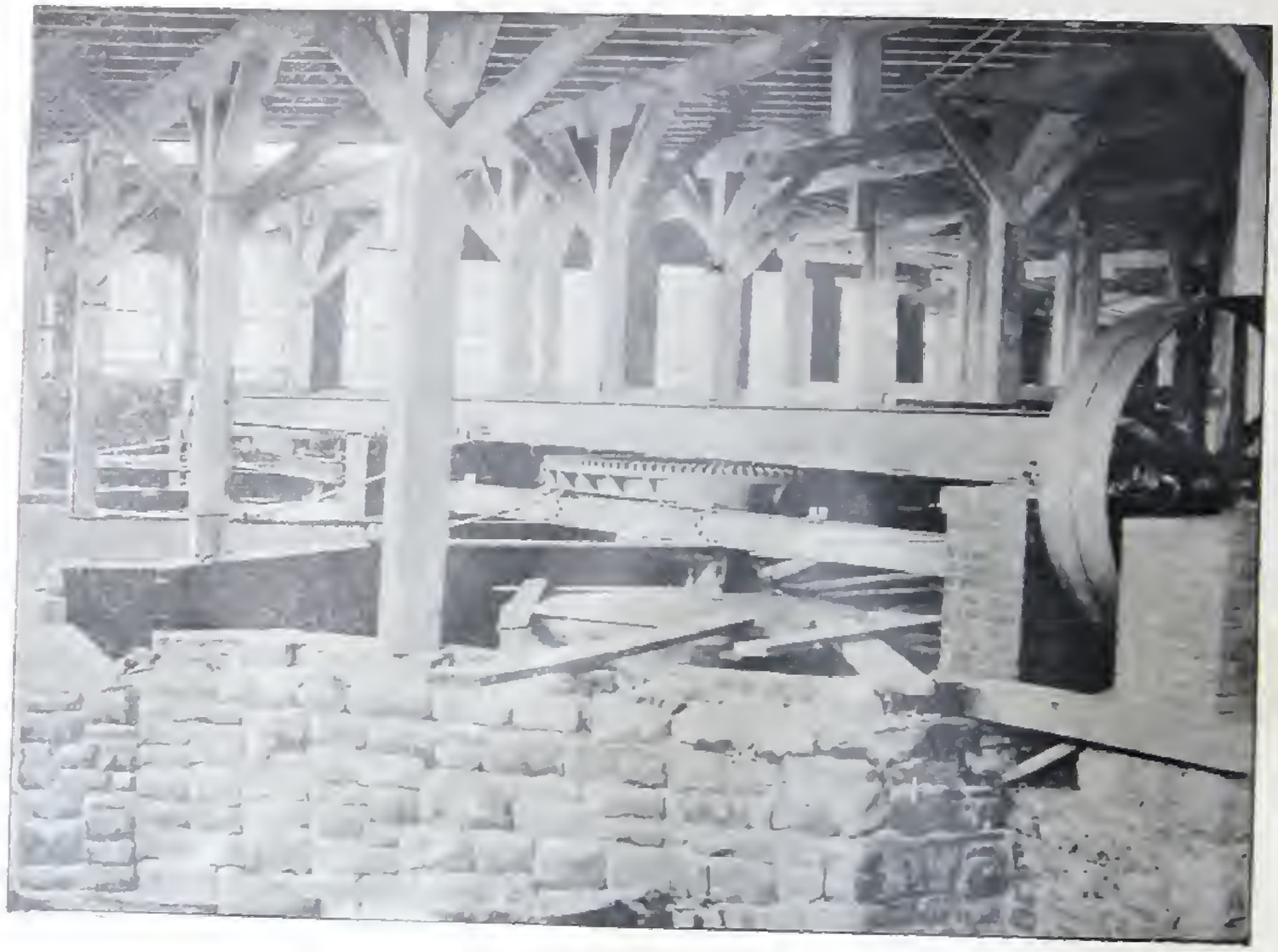
a building stone in England at that time. Aspdin's first patent was issued October 21st, 1824, (No. 5022), and was for "An Improvement in the Modes of Producing an Artificial Stone," and he thus describes his process: "My method of making a cement or artificial stone for stuccoing buildings, waterworks, cisterns, or any other purpose to which it may be applicable, (and which I call Portland cement), is as follows: I take a specific quantity of limestone, such as that generally used for making or repairing roads, after it is reduced to powder or puddle, but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself, and I cause the puddle or powder, or the limestone itself, as the case may be, to be calcined. I then take a specific quantity of argillaceous earth or clay and mix them with water to a state approaching impalpability, either by manual labor or machinery. After this proceeding I put the above mixture into a slip-pan for evaporation, either by the heat of the sun or by submitting it to the action of fire until the water is entirely evaporated. Then I break the said mixture into lumps and calcine them in a furnace similar to a lime kiln, until the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beaten or rolled to a fine powder, and is then in a fit state for making cement or artificial stone. This powder is to be mixed with a sufficient quantity of water to bring it into the consistency of mortar, and thus applied to the purpose wanted."

Aspdin in the year following took out a patent for a "Method of making lime," and for this purpose he collected road scrapings from roads repaired with limestone. These he dried and subsequently removed to a kiln to burn with coal, coke, or wood. The product was then ready for "building," or, "liming land."

Aspdin fails to point out the exact amount of clay needed, rather an important matter, and he omits to state that the calcining must be carried on to the point of incipient vitrification. These omissions may be regarded as casting some doubt upon the authenticity of

Marlbank Plant
Dredge working in fifty feet of marl and clay

Where the marl and the clay are prepared before admixture



Marlbank Plant
Two of the Wash Pits in course of construction

his discovery of Portland cement in 1824, but it is a well-known fact that he established a manufactory at Wakefield in 1825 for producing this article, which is still in existence, and his son William Aspdin also established a cement manufactory in the Thames district.

In 1847, General Pasley, in his work on Portland cement, mentions three manufacturers of Portland or artificial cements in England. "Pasley's Artificial" cement in 1836 gave a tensile strength of 34.9 lbs. to the square inch, in 11 days.

In 1880, Mr. I. C. Johnson, a veteran cement manufacturer of England, published some remarks about the mystery formerly surrounding the manufacture of Portland cement, and adds: "As I said before, there were no sources of information to assist me. Although Aspdin had works, there was no possibility of finding out what he was doing, because the place was closely built in with walls twenty feet high, and with no way into the works except through the office. Even if I had gained access to the works, I probably would have learned but little, for the process was so mystified that even the workmen knew nothing about it, and considered that the virtue consisted of something Aspdin did with his own hands. He had a kind of tray with several compartments, and in these he had powdered sulphate of copper, powdered limestone and other materials. When a layer of dried slurry and coke had been put into the kiln, he would go in and scatter some handfuls of these powders from time to time as the loading proceeded, so as to surround the whole process with as much mystery as possible. I had a laboratory of my own, and I worked night and day to find out how the cement was made. Finally I tried quicklime, powdered, and mixed with clay and calcined, by which means I got something nearer. After that I used chalk and clay, but too much chalk in proportion and the resulting compound being highly burned, swelled and cracked. By mere accident, however, some of the burned stuff was clinkered, and, as I thought, useless. However, I pulverized some of the clinkers and gauged it. It did not

seem as though it would harden at all, and no warmth was produced. On examining it some days later, I found it much harder than any of my other samples, and moreover the color was a nice grey. Supposing that at last I had the right clue, I went in on a larger scale, using five of chalk to one of clay. This was well burnt and finely ground, but it was a failure on account of excess of lime. The whole of this material was tossed away as useless, and remained in a corner for some months, after which I had the curiosity to test it and gauged it as before, when, to my astonishment, it gauged smoothly and did not crack and blow as before, but became solid and increased in hardness with time. Cogitating as to the cause, it occurred to me that there had been an excess of lime, and that the exposure in a damp place had caused the lime to slake. This was another step in advance, and I went on experimenting until I came to five of chalk and two of clay, and this gave results so satisfactory that this cement was soon set up as a standard by the French Government Works, to which all subsequent purveyors had to conform."

Spencer B. Newberry, in a paper on "The Production of Portland Cement" in 1900, says: "The total European product of Portland cement for the year is estimated to be equivalent to 44,000,000 barrels. Of this quantity Germany produces about 15,000,000 barrels. This production is considerably in excess of the demand, and during the past year, especially in England and Germany, the industry has been in a very depressed condition, as shown in the great decline in the price of securities of the leading manufacturing companies."

The growth of the industry in Canada has kept well in pace with that of the other leading industries of the Dominion. In the year 1890 not more than 30,000 barrels of cement could have been manufactured in this country, while the consumption during the same year could not have exceeded a total of 100,000 barrels. In the year 1901 the consumption in Canada must

Where the
marl and
the clay
are converted
into slurry
by admixture

Marlbank Plant. Partial View of Mixing Room

Where the slurry is burnt into clinker

Marlbank Plant. Partial view of the Rotary Kilns

have approximated very close to one million barrels, the greater part of which was made by Canadian manufacturers.

The growth in production and consumption of Portland cement throughout the world during the past century, and in Canada during the past decade, point very clearly to its much wider and more varied use for the future as the most economical as well as satisfactory building material known, meeting every requirement of conditions, which are frequently difficult and which every year are becoming more exacting.

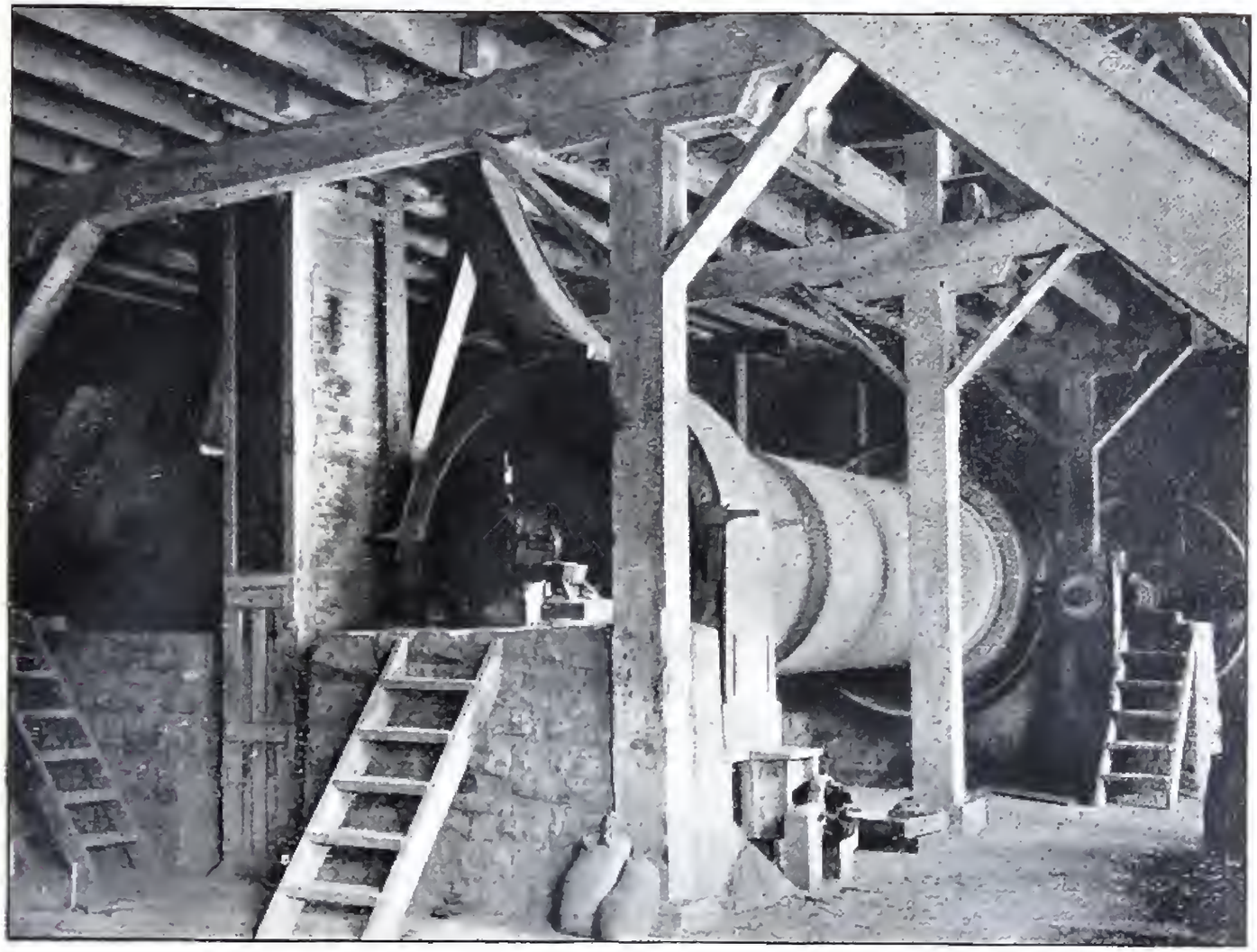
Extracts from the Report of the Board of Engineers, United States Army, on the Properties and Testing of Hydraulic Cement

A Board of Engineers, consisting of Major W. L. Marshall, Major Smith S. Leach and Capt. Spencer Crosby, was appointed by order of Brigadier General John M. Wilson, Chief of Engineers, U. S. Army, to investigate and report upon the subject of manipulating and testing hydraulic cements. The report is printed in number Twenty-eight of the Professional Papers of the Corps of Engineers.

General Considerations

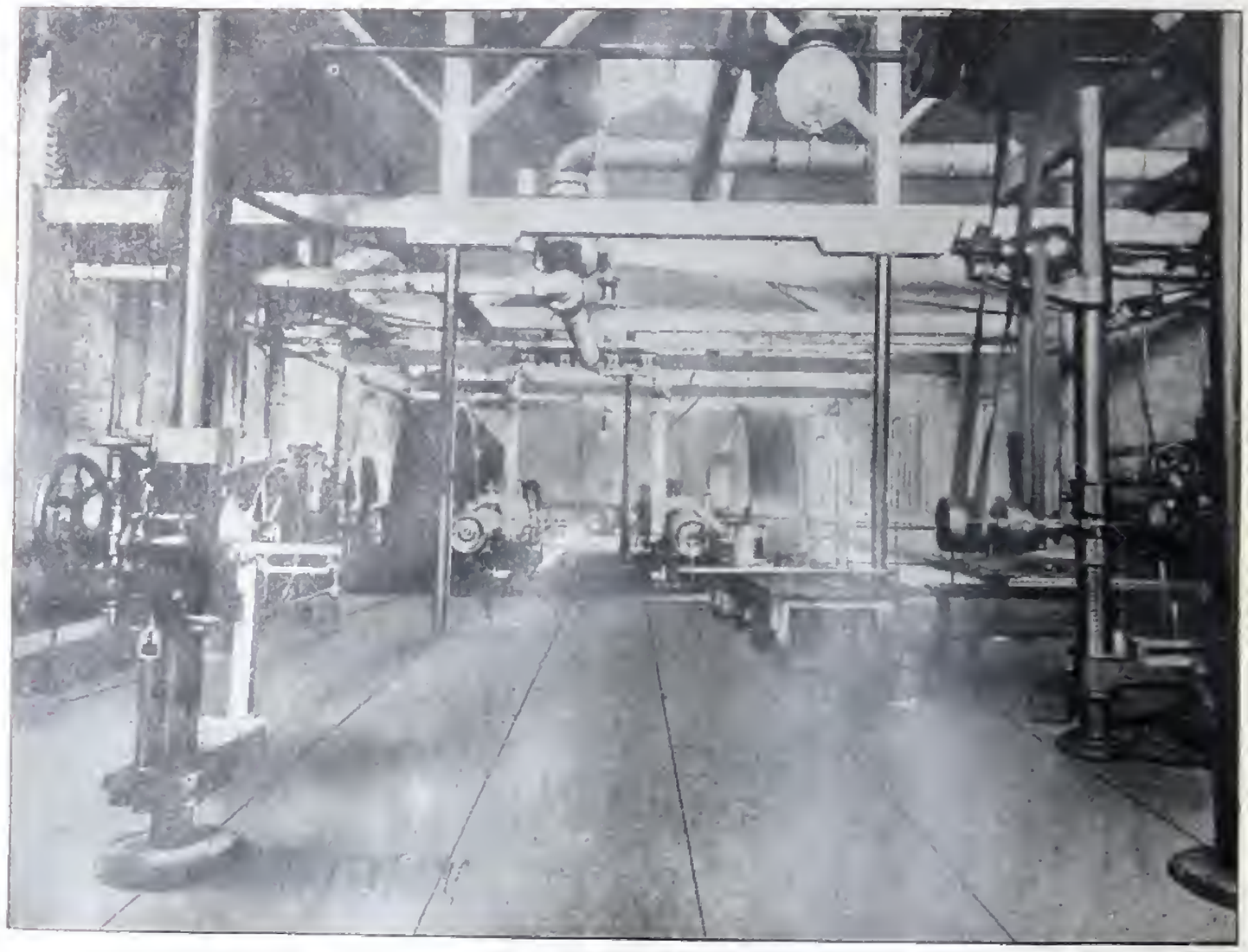
"The constructing engineer is confronted by no problem more difficult than to decide whether a certain cement, when placed into work, will behave in a predetermined way.

The difficulties arise from the fact that tests for acceptance or rejection must be made on a product not in its final stage. A cement, when incorporated in masonry, undergoes for months chemical changes in the process of setting, so that the material subjected to strains in the work is not the material tested, but a derivative of it. The object of tests is to establish two probabilities: First, that the product of the given cement will develop the desired strength and hardness soon enough to enable it to bear the stresses designed for it; second, that it will never thereafter fall below that strength and hardness. Up to the present time it appears that the relation between the chemical and physical properties of raw cement and of its partially indurated derivatives, determined by tests, and the physical properties of the same cement or its derivatives, after complete hydration and induration in the work, can be stated only within rather wide limits.



Where the clinker is ground into cement

Marlbank Plant. One of the Tube Mills



Marlbank Plant Engine Room

Tests to be Made

For selecting Portland cement from among the brands offered, the Board recommends that the following tests be made: (1) FOR FINENESS OF GRINDING; (2) FOR SPECIFIC GRAVITY; (3) FOR SOUNDNESS, OR CONSTANCY OF VOLUME IN SETTING; (4) FOR TIME OF SETTING; (5) FOR TENSILE STRENGTH.

In determining the minimum requirements for cements given in the subjoined specifications, we recognize that many cements that attain only fair strength neat and with sand in a short time and show marked gains of strength on further time will fulfill the requirements of the service, and that unusually high tensile strength attained in a few days after gauging is often coupled with a small or negative increase in strength in further short intervals. Usually high tests in a short time after gauging should be regarded with suspicion. The practice of offering a bonus or free gift of money in addition to the contract price for cement testing above a fixed high point should be prohibited as unnecessary, for cements so obtained are likely to be unsound in a manner not easily detected in the time usually available in testing.

Manipulation of Cements for Tests

FINENESS. Place 100 parts, (denominations determined by subdivisions of the weighing machine used), by weight, on a sieve with 100 holes to the linear inch, woven from brass wire No. 40, Stubb's wire gauge; sift by hand or mechanical shaker until cement ceases to pass through.

It is Only the Impalpable Dust that Possesses Cementitious Value.

Fineness of grinding is, therefore, an essential quality in cements to be mixed with sand. THE RESIDUE ON A SIEVE OF 10,000 MESHES TO THE SQUARE INCH IS OF NO CEMENTITIOUS VALUE, AND EVEN THE GRIT RETAINED ON A SIEVE OF 40,000 OPENINGS TO THE SQUARE INCH IS OF SMALL VALUE.

Specific Gravity

The standard temperature for specific gravity determinations is 62° F. But for cement testing temperatures may vary between 60° and 80° F. without affecting results more than the probable error in the observation. Use any approved form of volumenometer or specific gravity bottle, graduated to cubic centimeters with decimal subdivisions; fill the instrument to zero of the scale with benzine, turpentine, or some other liquid having no action on cements; take 100 grams of sifted cement that has been previously dried by exposure on a metal plate for twenty minutes to a dry heat of 212° F., and allow it to pass slowly into the fluid of the volumenometer, taking care that the powder does not stick to the sides of the graduated tube above the fluid and that the funnel through which it is introduced does not touch the fluid. Read carefully the volume of the displaced fluid to the nearest fraction of a cubic centimeter. Then the approximate specific gravity will be represented by 100 divided by the displacement in cubic centimeters. The operation requires care.

Piers built with a cement assuring safety and permanency

North end of The Ottawa & New York Railway Bridge over the St. Lawrence River, Cornwall. Built with "Rathbun's Star"

Foresters' Temple Building, Toronto.
Built with "Rathbun's Star"

Setting Qualities and Soundness

The quantity of water and the temperature of water and air affect the time of setting. The specifications contemplate a temperature varying not more than 10 degrees from 62° F. and not more than 20% of water. Mix thoroughly for five minutes, vigorously rubbing the mixture under pressure; time to be estimated from moment of adding water, and to be considered of importance.

Make on glass plates two cakes from the mixture, about 3 inches in diameter, ½ inch thick at middle, and drawn to thin edges, and cover them with a damp cloth or place them in a tight, damp box, not exposed to currents of dry air. At the end of the time specified for initial set apply the needle, $\frac{1}{12}$ inch in diameter, weighted to ¼ of a pound, to one of the cakes. If an indentation is made the cement passes the requirement for initial setting; if no indentation is made by the needle it is too quick setting. At the end of the time specified for final setting apply the needle $\frac{1}{24}$ inch in diameter, loaded to one pound. The cement cake should not be indented.

Expose the two cakes to air under damp cloth for 24 hours. Place one of the cakes, still attached to its plate, in water for 28 days; the other cake immerse in water at about 70 degrees temperature, supported in a rack above the bottom of the receptacle; raise the water gradually to the boiling point and maintain this temperature for six hours, and then let the water with cake immersed cool. Examine the cakes at the proper time for evidence of expansion and distortion. Should the boiled cake become detached from the plate by twisting and warping, or show expansion cracks, the cement may be rejected, or it may await the result of 28 days in water. If the fresh-water cake shows no evidence of swelling, the cement may be used in ordinary work, in air or fresh water, for lean mixtures. If distortion or

expansion cracks are shown on the fresh-water cake, the cement should be rejected. Of two or more cements offered, all of which will stand the fresh-water tests for soundness, the cements that will stand the boiling tests also are to be preferred.

Tensile Strength

NEAT TESTS. Use unsifted cements. Place the amount to be mixed on a smooth, non-absorbent slab; make a crater in the middle sufficient to hold the water; add nearly all the water at once; the remainder as needed; mix thoroughly by turning with a trowel, and vigorously rub or work the cement for five minutes.

Place the mould on a glass or slate slab. Fill the mould with consecutive layers of cement, each when rammed to be ¼ inch thick. Tap each layer 30 taps with a soft brass or copper rammer, weighing 1 lb. and having a face ¾ inch diameter or $\frac{7}{10}$ inch square, with rounded corners. The tapping or ramming is to be done as follows: While holding the forearm and wrist at a constant level, raise the rammer with the thumb and forefinger about ½ inch and then let it fall freely, repeating the operation until the layer is uniformly compacted by 30 taps.

This method is intended to compact the material in a manner similar to actual practice in construction, when a metal rammer is used, weighing 30 pounds, with a circular head 5 inches in diameter, falling about 8 inches upon layers of mortar or concrete 3 inches thick. The method permits comparable results to be obtained by different observers.

After filling the mould and ramming the last layer, strike smooth with the trowel, tap the mould lightly in a direction parallel to the base plate to prevent adhesion to the plate, and cover for 24 hours with a damp cloth. Then remove the briquette from the mould and immerse it in fresh water, which should be renewed twice a week for the specified time, if running water is not available for a slow current.

A place
where
conditions
demanded
only
the best

Ottawa and Hull Power Co.'s Plant, Hull, Que.
Work being done with "Rathbun's Star"

Conditions surrounding railway bridge construction demand the most substantial piers

South end of The Ottawa & New York Railway Bridge
over the St. Lawrence River, Cornwall, Ont.
Rebuilt with "Rathbun's Star"

Heavy foundations built with a GUARANTEED cement

Belgo-Canadian Pulp Company's Plant, Shawenigan Falls, Que.
Built with "Rathbun's Star"

Granolithic Walks add beauty to their surroundings

Walks about Provincial Parliament Buildings, Toronto
Laid with "Rathbun's Star"

Monolithic Residence built by J. F. Maunder, Ottawa, Ont., with "Rathbun's Star."

A style of
cement concrete
construction
combining
strength,
beauty,
durability and
cheapness

Cement used in concrete exposed to sea water must be free from adulterations

Canadian Pacific Railway Grain Elevator, St. John, N.B.
Foundations built with "Rathbun's Star"

Piers to withstand tremendous ice shoves

Bridge over the Saskatchewan River, Edmonton, Alberta
Built with "Rathbun's Star"

Concrete
Silos made
with the
best cement
are cheapest
for the farmer.
They are
the greatest
sand carriers

George Lithwaite's Silo, Goderich, Ont.
Built with "Rathbun's Star"

Borings after completion showed that these piers had become homogeneous masses of enormous strength

Ottawa-Hull Interprovincial Bridge
Built with "Rathbun's Star"
Under the supervision of the Chief Engineer of the
Federal Department of Railways and Canals

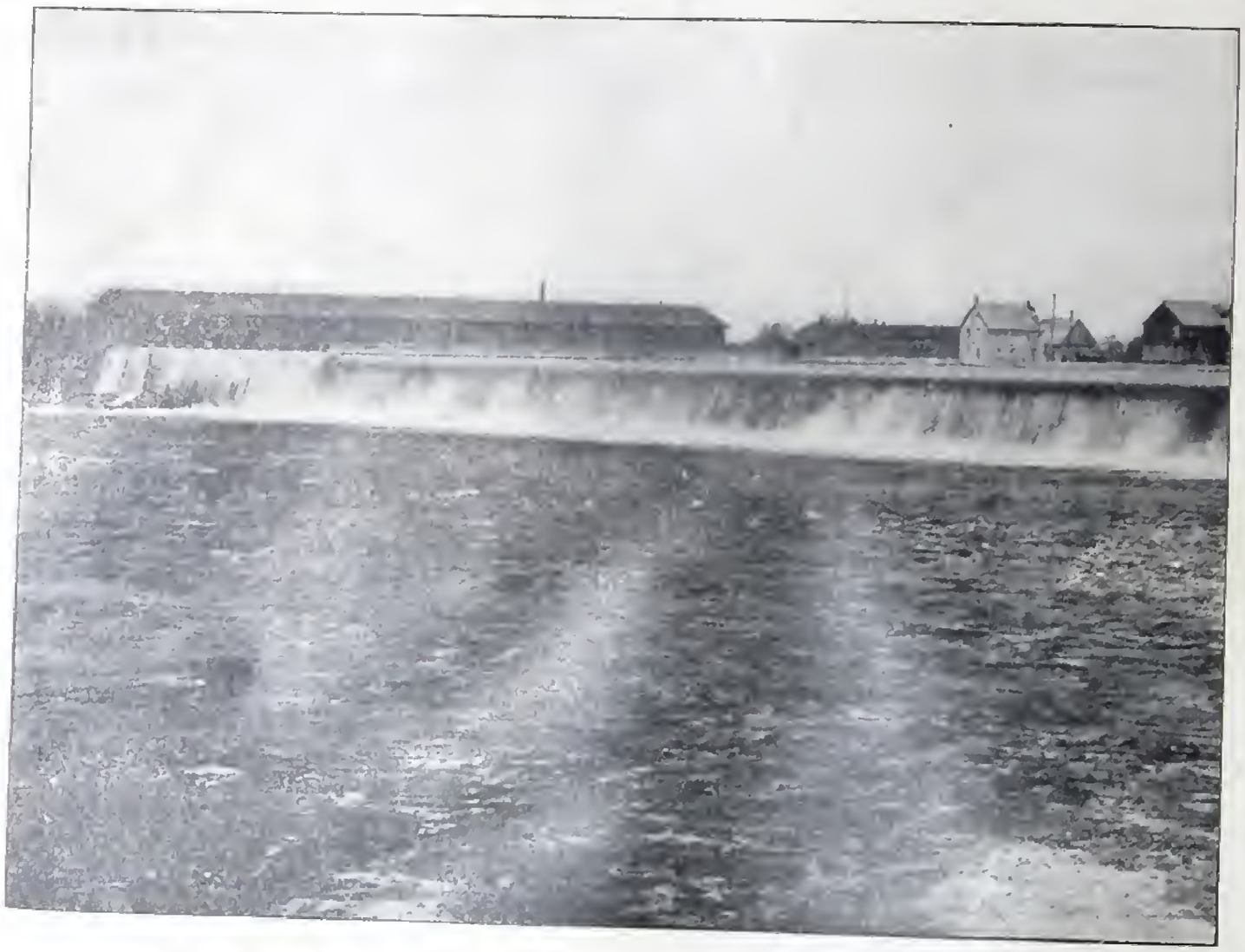
Good Granolithic Walks mean "No maintenance cost"

Walks, Bank of Montreal, Belleville, Ont.
Laid with "Rathbun's Star"

Timber bridge
piers,
WITH REPAIRS,
last for years.
Concrete bridge
piers,
WITHOUT REPAIRS,
last forever

A bridge over the Soulanges Canal
Built with "Rathbun's Star"

High-class firms use high-class cements



Royal Electric Co.'s Power Dam, Richelieu, Que.
Rebuilt in 1901 with "Rathbun's Star"

SAND TESTS. The proportions 1 cement to 3 sand are to be used in tests. Crushed quartz sand, sifted to pass a standard sieve with 20 meshes per linear inch and to be retained on a standard sieve with 30 meshes to the linear inch, is to be used.

After weighing carefully, mix dry the cement and sand until the mixture is uniform; add the water as in neat mixtures, and mix for five minutes by triturating or rubbing together the constituents of the mortar. This may be done under pressure with a trowel, or by rubbing between the fingers, using rubber gloves. The rubbing together seems necessary to coat thoroughly the facets of the sand with the cement paste.

It is found that prolonged rubbing, when not carried beyond the time of initial set, results in higher tests. Five minutes is the time of mixing quite generally adopted in European specifications. The briquettes are to be made as prescribed for neat mixtures.★

Three batches of four briquettes each of sand mixtures should be made, and one briquette of each batch may be broken at 7 and 28 days, giving three tests at each period. At least one batch of four briquettes of neat cement should be made.

IF THE FIRST BRIQUETTE BROKEN AT EACH DATE FULFILLS THE MINIMUM REQUIREMENT OF THESE SPECIFICATIONS IT IS NOT NECESSARY TO BREAK OTHERS, which may be reserved for long-time tests. IF THE FIRST BRIQUETTE DOES NOT PASS THE TEST FOR TENSILE STRENGTH, THEN BRIQUETTES MAY BE BROKEN UNTIL SIX BRIQUETTES, TWO FROM EACH BATCH, HAVE BEEN BROKEN AT SEVEN DAYS, and the remaining six reserved for 28 day tests. THE HIGHEST RESULT FROM ANY SAMPLE IS TO BE TAKEN AS THE STRENGTH OF THE SAMPLE WHEN THE BREAK IS AT THE LEAST SECTION OF BRIQUETTE.

★The addition of water by weight in the proportion of eighteen per cent of the quantity of the cement in neat mixtures and eight per cent. of the total quantity of sand and cement combined, in mortar mixtures, will give the highest possible results, other conditions being proper. A variation of even 2 per cent. in the proportion of water used will give a difference of from 20 per cent. to 30 per cent. in tensile strain.

If, on the 28 day tests, the cement not only more than fulfills the minimum requirements of these specifications, but also shows unusual gain in strength, it may still be accepted if the other tests are satisfactory, notwithstanding a low 7 day test, if early strength is not a matter of importance. Such cements are likely to be permanent.

For measuring tensile strength, A MACHINE THAT APPLIES THE STRESS AUTOMATICALLY AT A UNIFORM RATE IS PREFERABLE TO ONE CONTROLLED ENTIRELY BY HAND. These specifications for tensile strength contemplate the application of stress at the rate of 400 lbs. per minute to briquettes made as prescribed herein. A rate so rapid as to approximate a blow, or so slow as to approximate a continued stress, will give very different results.

The tests for tensile strength are to be made immediately after taking from the water, or while the briquettes are still wet. The temperature of the water during immersion should be maintained as nearly constant as practicable; not less than 50° nor more than 70° F.

Sampling

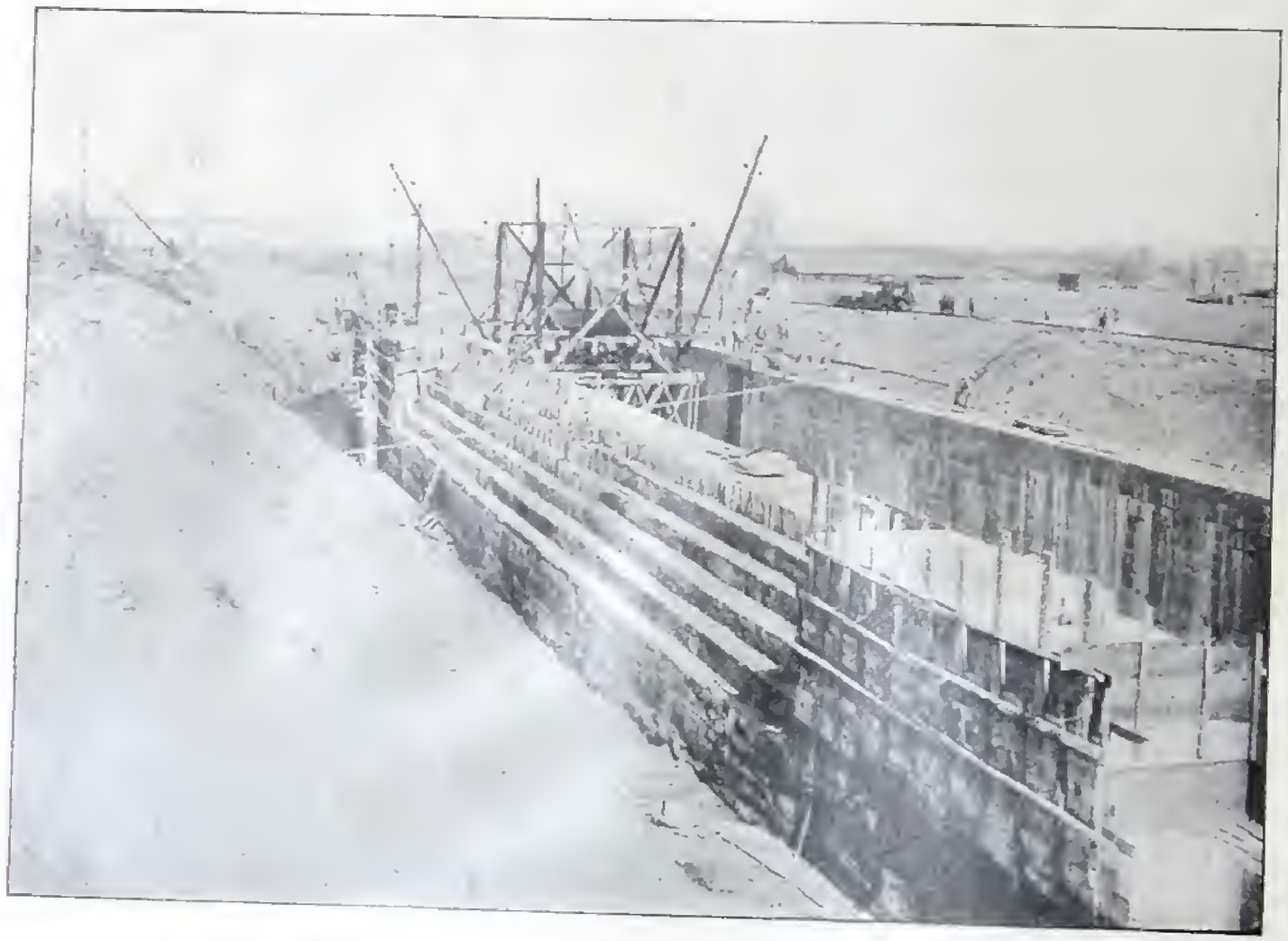
The entire package from parts of which tests are to be made is to be regarded as the sample tested. It should be marked with a distinctive mark that must also be applied to any part tested. The package should be set aside and protected against deterioration until all results from tests made from it are reached and accepted by both parties to the contract for supplies.

Cement drawn from several sample packages should not be mixed or mingled, but the individuality of each sample package should be preserved.

The best cement may cost most. Its working strength makes it cheapest

Making Drain Tile at Pembroke, Ont.
W. J. Devitt using "Rathbun's Star"

The best cements are the greatest sand carriers



Lock walls in course of construction, Soulanges Canal, with "Rathbun's Star"

In Testing it should be borne in mind that a few tests from any sample, carefully made, are more valuable than many made with less care.

In extended tests the material should be taken from the sample package from the heads and centre of barrel, and from the ends and centre of bag, by such an instrument as is used by inspectors of flour. All material taken from the same sample package may be thoroughly mixed or mingled, and the tests be made therefrom as showing the true character of the contents of the sample package.

In making formal tests at the work for acceptance of cement, sample packages should be taken at random from among sound packages. The number taken must depend upon the importance and character of the work, the available time, and the capacity of the permanent laboratory force.

For Tensile Strength the Tests with Sand are Considered the More Important, and Should Always be Made. TESTS, NEAT, SHOULD BE MADE IF TIME PERMITS."

Out of some Thirty Miles of cement sidewalks laid in the city of Toronto during the years 1900 and 1901

Twenty-Five Miles

were laid with

"Rathbun's Star"

River Sand vs. Bank Sand

The necessity of using ONLY clean, sharp river sand where cement work of good quality is required cannot be more forcefully illustrated than by the following comparative tests made in the laboratories of the Canadian Portland Cement Company, at the instance of a large consumer of cement, in November, 1901.

Briquettes were made from the same cement throughout the tests.

River Sand				**Bank Sand**			
Tensile Strength:				*Tensile Strength:*			
3 parts of Sand to 1 of Cement.				3 parts of Sand to 1 of Cement.			
7 Days.				7 Days.			
170	lbs.	per	square inch.	40	lbs.	per	square inch.
180	"	"	"	55	"	"	"
AVERAGE 175	"	"	"	AVERAGE 47½	"	"	"

The above strengths verify the results frequently obtained in the same and other laboratories in similar tests during the past few years.

City Hall, Toronto, Ont. Built with "Rathbun's Star"

"Do not try the experiment of building works out of cheap, lean concrete; consider the relatively small saving a few barrels more or less of cement amounts to in comparison with the value and importance of the work at stake. Our reputation as engineers wil depend upon our capacity to do good, sound work."

The many letters written by some of

The Best Engineers
The Best Architects
The Best Contractors

of Canada, speaking in the most flattering terms of

"Rathbun's Star"

and

"Beaver"

are not printed for the sake of advertisement in this Brochure. Ask the best men for their opinions.

Failures in cement work are frequently made with good, as with poor cements, because of the treatment to which they are subjected.

To Make Good Concrete

USE only clean, coarse, sharp sand, free from clay, loam or mica. The presence of any one of these often proves fatal in cement work. If possible the sand should be river or sea washed; the coarser, the better. Cement mixed with very fine sand cannot properly envelop all the particles, a very necessary condition to the best results. The sand should be evenly spread upon the mixing board.

The quality of sand recommended in Portland cement mixtures will give from two to four times greater strength than can possibly be obtained in mixtures of this material under exactly similar conditions with the ordinary red bank sand. See comparative tests, page 21.

ADD only sound, finely ground cement. The virtue of fine grinding of cements can only be appreciated when those possessing this quality are brought into competitive tests with the more coarsely ground grades. Fineness permits such addition of sand as will much more than offset the mere difference in price of the coarser cements. The soundness or unsoundness of a cement depends upon the absence or presence of free lime as a constituent. Its presence is the most dangerous and deceptive weakness of many of the lower grades of quick-setting cements, and when water is added an unnecessary degree of heat is generated, with a consequent rapidity of setting and drying, which should be looked upon with suspicion, but which more often is taken as an indication of excellence of the material. Its presence will be followed later by a very serious disintegration of the work through its gradual contact with air or water. For permanency and safety, slow setting cements are

Work to withstand wear and weather

Concrete Bridge Piers. Soulanges Canal
Built with "Rathbun's Star"

Concrete Drain Tile and Road Bridges last for all time

Eastern Ontario Good Roads Association Train in operation at Gananoque, Ont.
The Portland Cement used by this train during 1901 was supplied exclusively by
The Canadian Portland Cement Co.

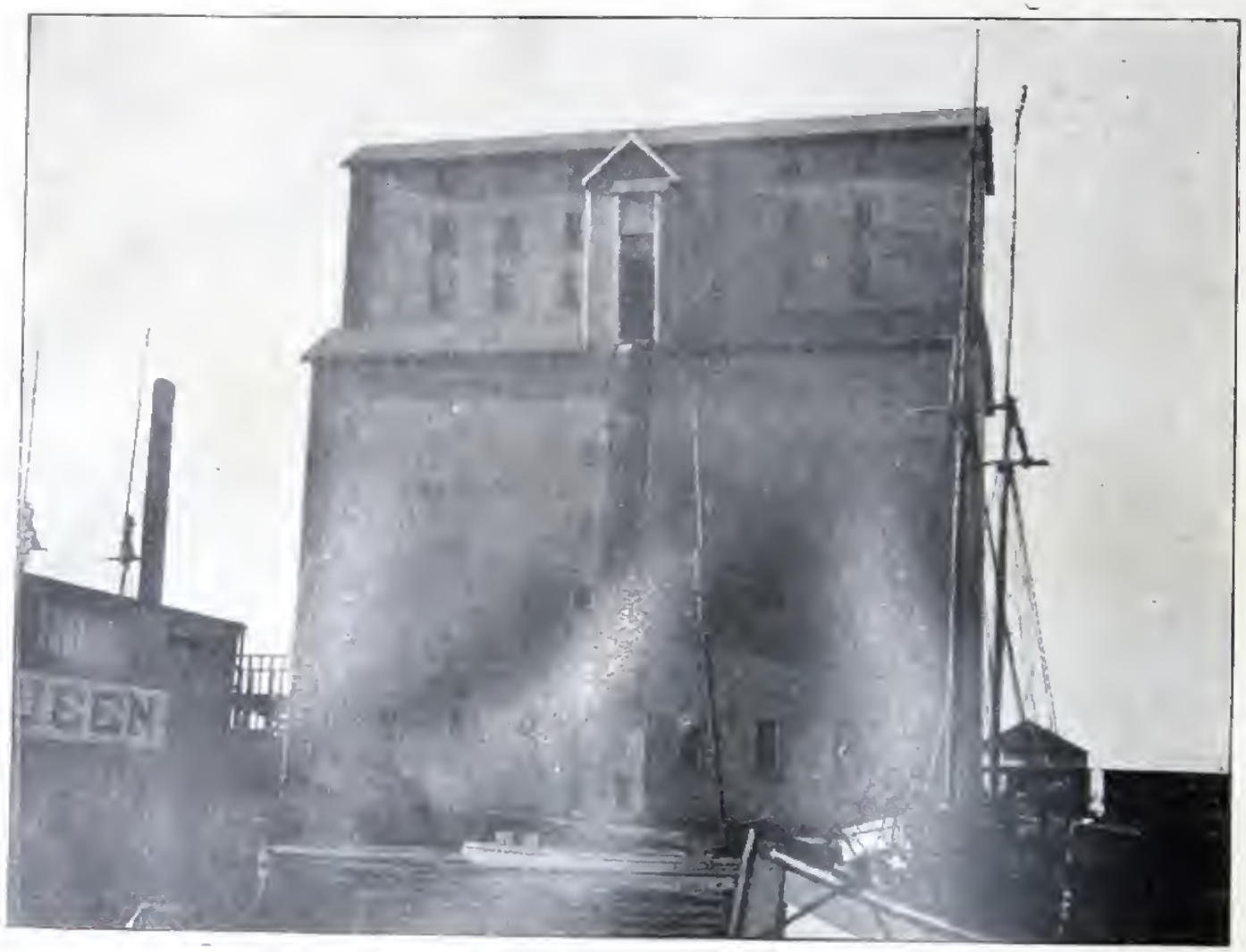
the better. Care should be taken to keep cement, when in store, perfectly dry. Cement in damp places must, from its very nature, at least partially set, with a consequent deterioration in value; Spread the cement carefully and evenly over the dry sand.

MIX the sand and the cement thoroughly when dry. A very serious error in mixing cement mortar is that of adding water to either the sand or the cement before a thorough, dry mixing of the latter two materials. The addition of water to either, alone, throws the cement into a paste, resulting in a mixture made of separate bodies of cement and sand. All sticks, scraps of paper, etc., should be removed from the sand and the cement, and these materials thoroughly turned together dry at least three times.

USE only pure, clean water. Water taken from stagnant pools acts detrimentally upon cement. Excess of water drowns the cement, each particle setting more or less independently of its neighbor, resulting in a body weakened by lack of close contact of the cement particles instead of a strongly bonded mass. An excess of water gives a mortar, very lightly and easily handled, but is only used by those regardless of strength and permanency of work. The addition of enough water to make the mortar of such consistency as will stand stiffly upon a trowel is quite sufficient, unless the preparation is being used for grouting.

ADD only clean, broken stone, or soft coal cinders, which have been first thoroughly washed down. The thorough washing down of these materials not only removes all particles of clay, loam or dirt, all of which are very injurious to cement work, but provides them with moisture, which otherwise would be quickly drawn from the mortar itself, leaving insufficient water therein to provide for the complete chemical change which the full process of setting requires. The stone or the coal cinders should be thoroughly turned with the cement mortar at least two or three times.

Elevator foundations carry tremendous weights



The Richardson Grain Elevator, Kingston, Ont.
Foundations built with "Rathbun's Star"

Granolithic Walks and Floors

A very important provision for the laying of walks and cellar floors, is the proper drainage of the surface to be paved. Where the bed to be paved offers no natural drainage, it is usual to excavate to a sufficient depth to allow the placing of a layer of broken stone or gravel, varying in depth from four to twelve inches. The latter quantity is used where pavements are constantly exposed during the winter season to the action of frost, and in some cases it is necessary also to use porous drain tile.

It is advisable to divide concrete when laying walks, usually into five feet sections. A special tool is used to cut the concrete, leaving a space between the blocks, generally one-half inch in width. This opening is then filled with dry sand. These divisions provide for a certain degree of upheaval of sections as a result of the action of frosts, avoiding an otherwise inevitable cracking of the surface.

To procure the greatest possible strength for floors and walks it is necessary that the top dressing or finish be laid almost immediately after the concrete is put into place. It is very necessary that the bond between the concrete and the top dressing should be perfect. If the finish is laid after the concrete has set, a space is left between the two layers, into which water will find its way in wet weather, and this, during frosty weather, is the cause of the upheaval of the top layer. Thorough drainage and a perfect union of the two layers is absolutely essential to durability.

Too much trowelling of the top dressing frequently results in a crumbling surface later. The sprinkling of the surface with dry cement to absorb the surplus water is also attended frequently with poor results, unless the workman be thoroughly competent. This

addition of neat cement, if it is made at all, must be thoroughly trowelled, or it will scale off. In this connection it is advisable to use a smaller quantity of water. The sprinkling of the dry cement will then be quite unnecessary.

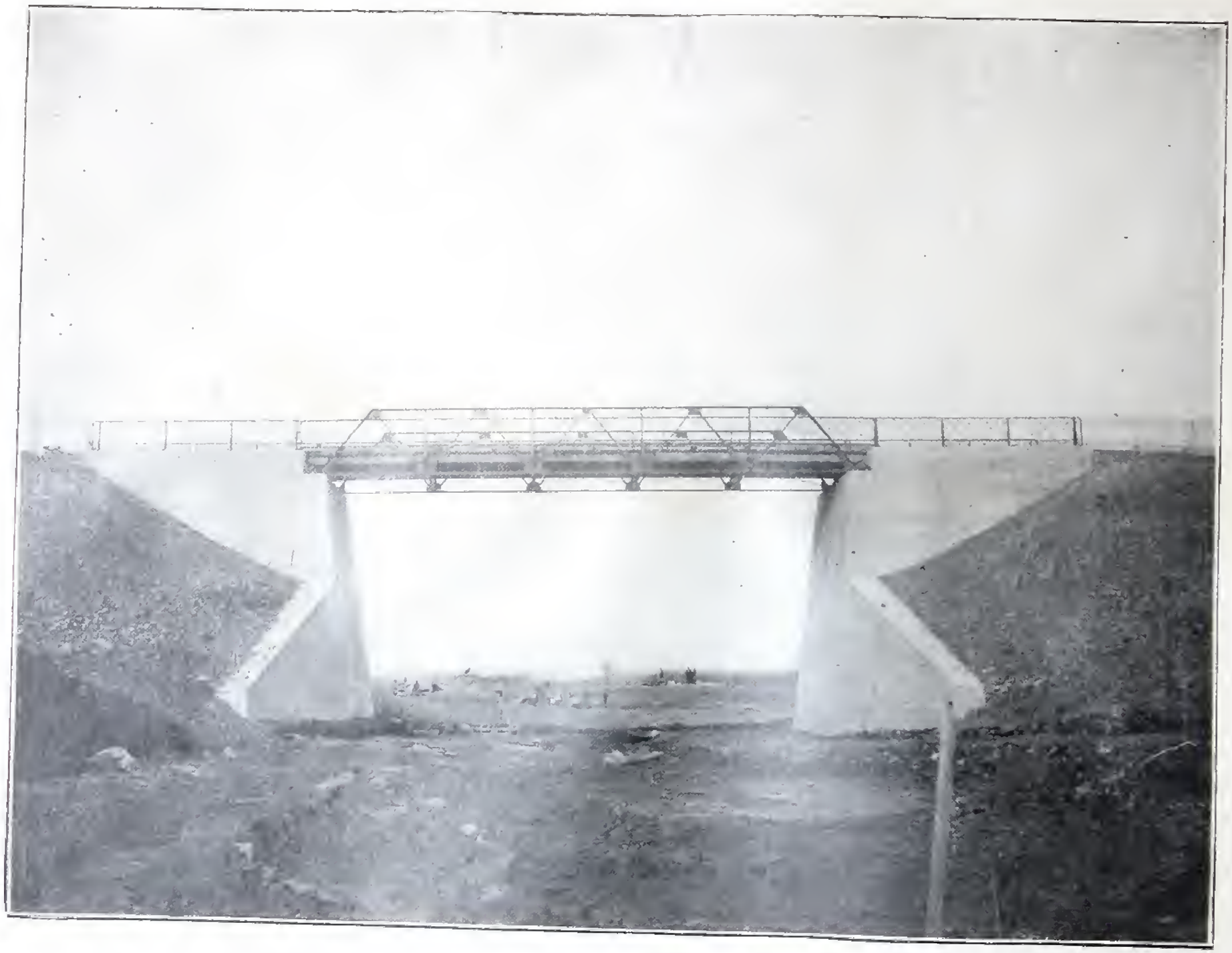
A common fault in cement work is the excessive use of water, seriously prolonging the time of set, as well as reducing the ultimate strength. In concrete the result is the presence of many voids and a proportionately weakened mass.

Walks and floors when laid in warm weather, or when exposed to heat of any nature, should be covered with canvas or coarse cotton, kept damp until the cement has thoroughly hardened. Sprinkling lightly for a few days after is most beneficial.

Concrete power dams built with sound cement grow in strength with age

Canadian Electric Company's Power Dam, Chaudiere, Que.
In the construction of which several thousand barrels of "Rathbun's Star" were used.

Not built for repairs



Concrete Bridge Piers (33 feet high), Trent Valley Canal
Built with "Rathbun's Star"

Cement Used Under Water

When necessary to use cement concrete or mortar, under water, great care should be taken that the water be still. Flowing water will invariably separate the cement from the sand.

Pointing Walls

Whether a wall be built of brick or stone, it is most important that sufficient of the old mortar be removed from the joints to provide "keys" for the proper adhesion of the fresh mortar. The cleaned joints should then be well wetted, and the work frequently sprinkled lightly afterwards with water, until the mortar has thoroughly hardened.

Plastering

The wall should be cleaned in the same manner as prescribed for pointing, the brick or stone itself thoroughly washed and wetted, and the work afterwards kept damp, in the same manner as in pointing, and until the same results are obtained.

Specifications for Mixtures for Cement Work

Concrete for Foundations:

1 Part Portland cement.
3 Parts clean, coarse sand.
5 to 6 Parts clean stone or brick, broken to irregular sizes, not exceeding two inches in diameter.

Concrete for Cellar Floors:

1 Part Portland cement.
4 Parts clean, coarse sand.
6 Parts broken stone, brick or gravel.

Top Dressing or Finishing for Walks or Floors:

1 Part Portland cement.
2 Parts crushed granite or limestone or sifted gravel.

Pointing Mortar:

1 Part Portland cement.
3 Parts clean, coarse sand.

Plastering Mortar:

1 Part Portland cement.
2 Parts clean, coarse sand.

The proportion of sand used in mortar for plastering must be less than that for other purposes, as a lean plastering mortar will be "short," making the work much more difficult.

Brickwork and Masonry Mortar:

For Brickwork—1 Part Portland cement.
3 Parts clean, coarse sand.

For Masonry—1 Part Portland cement.
4 Parts clean, coarse sand.

Very great care should be taken that the brick and stone be well wetted. Unless this is done, the moisture in the mortar necessary for the proper setting of the cement will be absorbed and the mortar itself left valueless.

Capacity of Portland Cement in Mixture

1 Barrel of Portland cement with 1 barrel of sand will cover 67 square feet 1 inch thick.
1 " " " 2 barrels " " 104 " 1 "
1 " " " 3 " " " 140 " 1 "

One barrel of Portland cement, three barrels of sand and six barrels of broken stone will yield two-thirds of a cubic yard of concrete.

A cement barrel has a capacity of about 3½ cubic feet.

Use of Cement in Frosty Weather

While it is best never to use Portland cement during frosty weather, fairly good results may be obtained by using water in which salt has been first completely dissolved, in quantities merely sufficient to prevent freezing, but care should be taken that the salt is first thoroughly dissolved before the addition of the water to the sand and the cement, for if mixed when not thoroughly in solution, or if added dry to the mortar after that is prepared, it will crystallize in small bodies by itself, very seriously weakening the work into which it enters. One pound of salt to every twenty gallons of water, when the thermometer is at 32° F., and one additional ounce of salt for every further degree below 32, is a fairly safe guide in the use of this material.

Heated water may be used, and the materials used with the cement should also be moderately heated, and if absorbent, should be immersed in warm water for some time previous to use. DO NOT HEAT THE CEMENT ITSELF.

If cement mortar or concrete can be kept from freezing until well set, and is not afterwards subjected to alternate freezing and thawing until thoroughly hardened, no injury will result from its use in frosty weather. If, however, the preparation is frozen before the final set takes place, the appearance of the work will undoubtedly be destroyed, and possibly the work throughout rendered valueless.

Crude Testing of Cement

A common practice amongst some workmen, with a view to testing cement, is to mix a small quantity with some proportion of sand upon a dry board, which is set aside, frequently exposed to the rays of the sun or to a very dry atmosphere. The board and the atmosphere very quickly absorb the moisture from the small body of the mixture, so that only partial setting is possible. The cement, which may be first-class, but slow setting, is pronounced worthless. A cement which may be worthless, but quick setting, or sufficiently rapid in action to use the water before it can be absorbed by the board and the atmosphere, is pronounced satisfactory. The only method of arriving at the value of a cement, ensuring safety and accuracy for the user and justice to the manufacturer, is to have it technically tested in a well equipped cement testing laboratory, where proper conditions are scrupulously observed.

A construction requiring tremendous powers of hydraulic resistance

Concrete Lift Lock, Trent Valley Canal. Built with "Rathbun's Star"

Cement concrete is rapidly displacing timber construction

Dredge and Gate Basin, Cascades Point, Que.
Entrance to Soulanges Canal. Built with "Rathbun's Star"
A construction to withstand heavy ice shoves

A Guarantee

EVERY BARREL OF "RATHBUN'S STAR" OR "BEAVER" IS GUARANTEED to fill the following specifications for FINENESS, SOUNDNESS AND STRENGTH.

Fineness:

Not more than eight per cent shall be retained on a standard wire sieve with 10,000 holes per square inch.

Not more than twenty-five per cent shall be retained on a standard wire sieve with 40,000 holes per square inch.

Soundness:

A thin pat of cement on glass, allowed to get hard in air, while covered with a moist cloth, and then submerged in water at 120° F. for twelve hours, must show no signs of warping, swelling or cracking.

Strength:

Neat briquettes, properly gauged with eighteen per cent by weight of water and compressed into moulds under a static pressure of at least twenty pounds per square inch, must show a tensile strength of 500 pounds per square inch after one day in moist air and six days in water, and 600 pounds per square inch after one day in moist air and twenty-seven days in water.

Mortar briquettes, gauged with eight per cent by weight of water, made of three parts of standard quartz sand to one part of cement by weight, and put into the moulds under

a static pressure of at least twenty pounds per square inch, must show a tensile strength of 150 pounds per square inch after one day in moist air and six days in water, and 200 pounds per square inch after one day in moist air and twenty-seven days in water.

The above specifications will be recognized by engineers, architects and contractors as ensuring a first-class cement. Any correct test of "RATHBUN'S STAR" ever made has shown strengths very much higher than those guaranteed above.

In the event of any misunderstanding as to the interpretation of these specifications, or the results obtained in testing, the decision of McGill College, Montreal, or the School of Practical Science, Toronto, is to be final.

Extract from a Paper by A. C. Davies, F. C. S., on English Grinding Machinery

It is well known that, in addition to the increased QUANTITY OF "AGGREGATE" FOR CONCRETE WHICH MAY BE USED WITH A FINELY GROUND CEMENT, so is the danger of disintegration obviated to a great extent; for the finer the powder the more easily is the free lime atmospherically—or with the water used for gauging—slaked. And, again, it has been shown that THE FINER THE CEMENT THE MORE DIMINISHED IS ITS COHESIVE POWER IN A NEAT TEST, BUT ON THE OTHER HAND THE CEMENTITIOUS VALUE OF THE CEMENT IS INFINITELY INCREASED BY FINE GRINDING.

Yet in England, more attention has been given to the old time tensile strength test with neat cement, AND THERE ARE STILL SOME ENGINEERS WHO PROFESS TO BELIEVE THAT LITTLE BENEFIT IS OBTAINED FROM FINE GRINDING. With these facts before them the English manufacturers find it of advantage to supply a coarse cement rather than a finely-ground product; and they will continue to do so, providing the situation satisfies the majority of cement users.

Significant

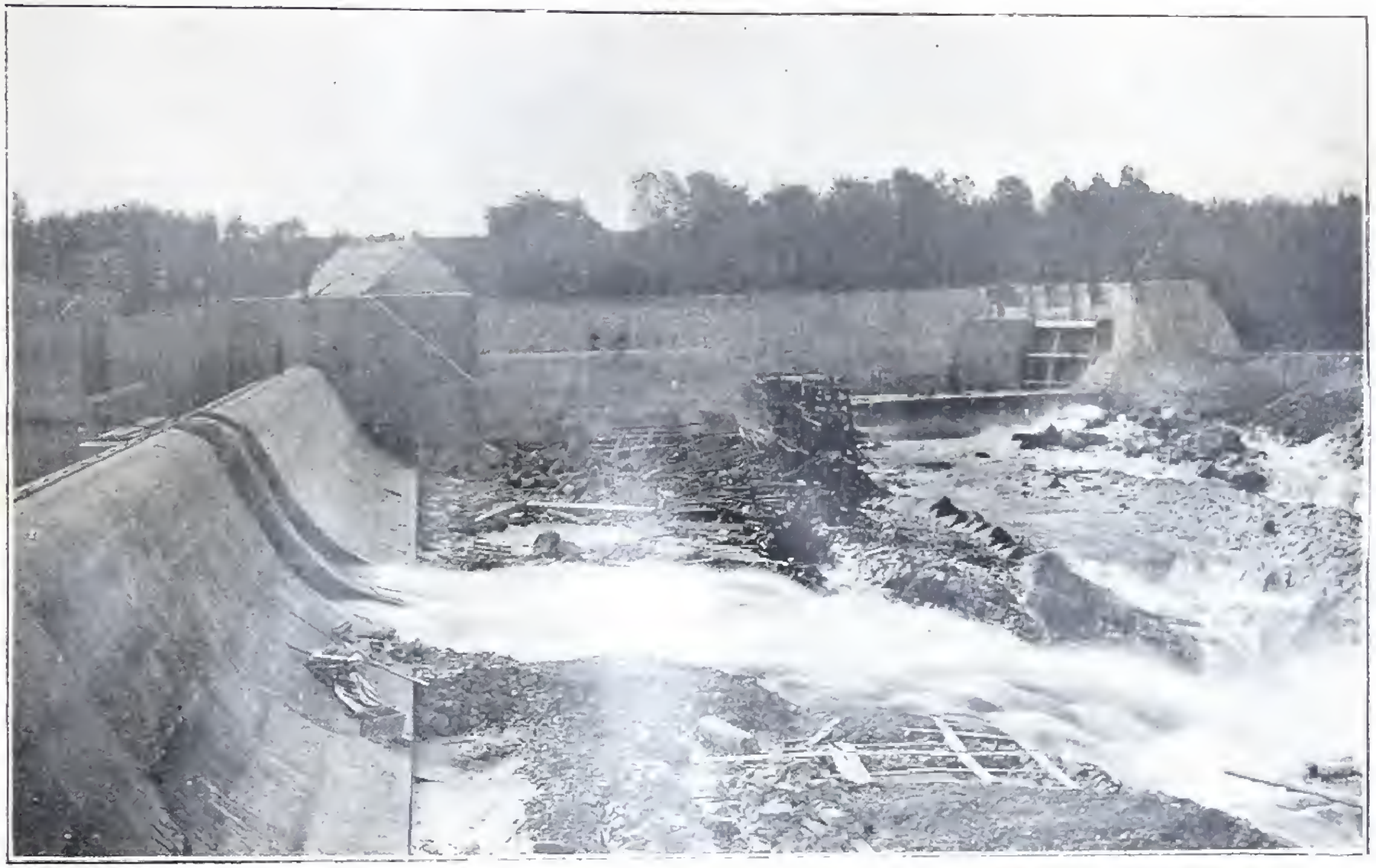
The Montreal Gazette,
Friday, 17th May, 1901.

"The arrivals of cement since the opening of navigation to date have been 2,727 barrels of 'Belgian' and 'German' and 1,400 'English,' as against 15,577 barrels of 'Belgian' and 'German' and 1,950 'English' for the same period in 1900, showing a decrease of 12,850 barrels of 'Belgian' and 'German' and a decrease of 550 'English.' The above small importations of foreign cement by the first vessels to arrive this season bear out the statement made in these columns a few weeks ago, that imports would decrease considerably this season, owing to the keen competition importers are meeting from Canadian manufacturers. The season's business so far in foreign brands has been very unsatisfactory, but a large trade has been done in Canadian brands. The Dominion Government gave out a contract for 23,000 barrels for the Trent Valley Canal this week to a Canadian maker."

THIS CONTRACT WAS AWARDED FOR "RATHBUN'S STAR."

Imports of European cements for 1900 to May 17th, 1900, . .	17,527 bbls.
Imports of European cements for 1901 to May 17th, 1901, . .	4,127 "
A decrease of 76.45 per cent, or	13,400 bbls.

None but the best good enough



Canadian Electric Company's Power Dam, Chaudiere, Que.
In the construction of which several thousand barrels of "Rathbun's Star" were used

A glimpse of the greatest canal system in the world

Entrance to Soulanges Canal, Coteau Landing, Que.
Built with "Rathbun's Star"
Thomas Monro, Superintending Engineer

Making Cement Pipe

E. Duryee, C. E.

Cement pipes, as usually used, are made by hand and on the ground near where they will be used. The common sizes are from eight to twelve inches for laterals, and from twenty-four to thirty-six inches inside diameter for main lines. The thickness is graduated from one inch for the eight-inch pipe to three inches for the thirty-six-inch pipe.

The proportions of cement and gravel used are one of cement to three, three and a half or four parts sand and gravel.

The sand and gravel are sometimes, but not always, screened for maximum and minimum limits of fineness.

To illustrate, the following is a specification for a twenty-four-inch pipe, two inches thick :

"The sand must be clean, coarse and sharp. The gravel must also be clean, with no pebbles larger than one and a quarter inches. The cement, sand and gravel must be measured in cubic foot measures, the top to be struck off level after filling.

The proportions to be one of cement to three of sand and gravel.

The cement and gravel must be put in a water-tight mortar box, where it must be worked over three times while dry, so that the voids will be uniformly filled with cement. Then water must be added through a hose or garden sprinkler until the cement and sand are thoroughly moistened.

The mortar will then be deposited quickly in the moulds by one man, while another

thoroughly tamps it into place with an iron tamping bar. Care must be used not to wet up more mortar at a time than can be used before the initial set of the cement occurs. Vigorous tamping is necessary. An excess of water must be avoided.

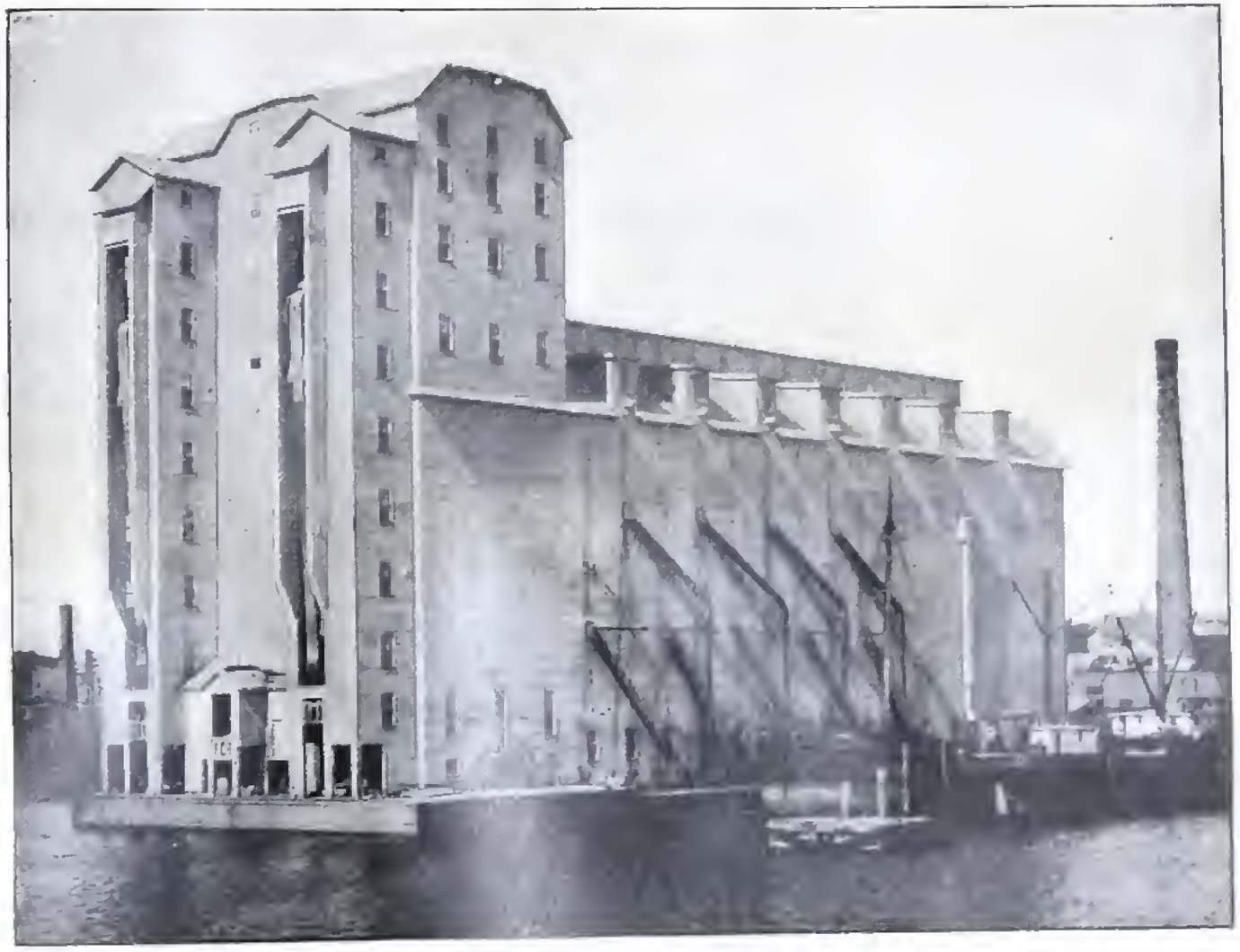
After removal from the mould, each section of pipe shall be coated with a wash of pure cement and water, of the consistency of paint, applied with a brush to the inside, to prevent seepage of water when in service.

The pipe must be kept damp, by frequent sprinklings, for a fortnight after being made."

Large pipes are usually made in sections two feet long, and the smaller sizes in two and a half or three feet lengths.

The moulds for pipe-making are made of iron plates rolled into semi-cylinders. These are hinged together on one side and clamped on the other so as to be quickly put into place and after the mortar has been tamped in, easily removed without injury to the green pipe.

Concave and convex cast-iron rings are used to shape the ends of the pipe, so that they will fit together closely when laid.



Montreal Transportation Company's Elevator. Kingston, Ont.
Foundations built with "Rathbun's Star"

Crib foundations weaken with age. Concrete foundations become indestructible

Five Tests of

"Rathbun's Star"

Some are very recent

Others were made some years ago. They all show remarkable uniformity and increasing strength.

THE CANADIAN PORTLAND CEMENT COMPANY
LABORATORIES.
February 1st, 1902.

Analysis—"Rathbun's Star"

Silica	21.36	per cent.
Iron Oxide	3.52	"
Alumina	6.5	"
Lime	63.28	"
Magnesia	1.44	"
Sulphur Anhydride	1.32	"

Tensile Strength—"Rathbun's Star"

Neat—	3 days	490 lbs.	per square inch.
	7 "	620 "	"
	28 "	720 "	"
	3 months	860 "	"
	6 "	930 "	"

Average results of tests made by the Osbourne Company of Cleveland, Ohio, of 296 samples of

"Rathbun's Star"

Portland cement for the Ottawa and New York Railway, and reported to F. D. Fisher, Chief Engineer, July, 1900. The samples were selected by an Engineer on the work, from several thousand barrels of this cement being used in the reconstruction of the piers of the Ottawa and New York Railway Bridge over the St. Lawrence River, at Cornwall, Ont.

Fineness:	Residue on No. 100 Sieve . . .	4.8 per cent.
Soundness:	Air Pats, Hot and Cold Water Pats, all O.K.	
Time of Setting:	Initial	1 hour 54 minutes.
	Final	5 hours 17 "
Tensile Strength:	Neat Briquettes, 24 hours .	418 lbs. per square inch.
	" " 7 days .	608 " " "
	Mortar " (3-1) 7 " .	218 " " "

McGill University, Montreal,
20th June, 1901.

Report of results of tests upon

"Rathbun's Star"

Brand of Portland cement. The samples were selected by Mr. J. W. Hill, contractor for the plant of The Belgo-Canadian Pulp Company, Shawenigan Falls, Que., from cement being used in that work, and received at the laboratories in sealed bottles, 22nd May, 1901.

Tensile Strength

Neat—	7 Days	671 pounds per square inch.
1 Cement to 3 Sand	—7 Days	207 pounds per square inch.

(Signed) Henry T. Bovey.
Per F. H. W.

McGILL UNIVERSITY.
TESTING LABORATORIES.

Report of results of tests upon

"Rathbun's Star"

Brand of Portland cement, for The New York and Ottawa Railway. Samples were selected by the senders from cement being used in the construction of the piers of the New York and Ottawa Railway bridge over the St. Lawrence River, at Cornwall, Ont. Samples received at laboratory 5th May, 1898.

Blowing Test: Entirely satisfactory.

Fineness: Residue on No. 120 sieve, . . . 4.7 per cent.
100 " . . . . 2.4 "
80 " . . . . 1. "
50 " . . . . .2 "

Tensile Strength: Neat— 1 day . . 233 lbs. per square inch.
7 days . . 816 " "
28 days . . 900 " "
3 Sand to 1 Cement — 7 days . . 220 " "
28 days . . 330 " "

(Signed) HENRY T. BOVEY.

McGill University.
Testing Laboratories.

Report of results of tests upon

"Rathbun's Star"

Brand of Portland cement. Samples selected by Mr. F. Dolan, contractor, Belleville, Ont., from cement being used by him at Smith's Falls, Ont., and received at the laboratories 10th May, 1901.

Blowing Test:	Entirely satisfactory.		
Fineness:	Residue on No. 120 sieve	. . .	2.03 per cent.
	100 "	. . .	1.01 "
	80 "	. . .	.35 "
	50 "	. . .	Nil.
Tensile Strength:	Neat, 3 days	. .	543 lbs. per square inch.
	3 Sand to 1 Cement "	. .	130 " " "

(Signed) Henry T. Bovey.

No longer time tests were made.

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